THE BREEDING SEASON OF UNIONIDÆ IN PENNSYLVANIA.

BY DR. A. E. ORTMANN.

(*Concluded from page 95.*)

Symphynota viridis Conr. August 24, '08, four gravid females were found among a dozen specimens; of 35 specimens collected by Dr. D. A. Atkinson on July 11, '08, not a single one was gravid.

Symphynota costata Raf. Autumn (Lea, III, '42); March, October (Lea, *ibid.*). I found gravid specimens in April, May (latest date, May 26), and then again in August (earliest date, August 9), September, October. Numerous specimens were collected in June and July, but none of them was gravid.

Symphynota complanata Barn. Autumn (Lea, III, '42); March (Lea, *ibid.*). Gravid females found on May 14, '08.

Alasmidonta undulata Say. September and October (Lea, II, '38). Gravid females on July 18 and August 12.

Alasmidonta heterodon Lea. August, September (Lea, II, '38); May (Lea, X, '63).

Alasmidonta marginata Say. October and December (Lea, II, '38). The western form was found gravid in August, September, October. Out of a number of specimens collected on June 5, 8 and 22 none was gravid. No dates at hand for July. The eastern form was found gravid on August 13. The western form (= *truncata* Wright = typical *marginata* Say) is hardly distinguishable from the eastern (=var. *varicosa* Lam.), see Pilsbry and Fox, NAUTILUS, '01, pp. 16 and 17).

GROUP B. SUMMER BREEDERS.

Some of the summer breeders (*Unio*, *Pleurobema*) have the outer gills only serving as marsupium, in others (*Quadrula*) all four gills are supposed to assume this function in the breeding season. Yet in many *Quadrulas* this condition is unknown, and, as we shall see below, the arrangement of the species into genera will need revision and correction. I enumerate the species here according to Simpson's Synopsis.

Unio gibbosus Barn. Summer breeder (Sterki, '95); July, August (Lea, III, '42). I found gravid females of this common species in June and July, and a single belated one on August 13. Hun-

dreds of individuals were collected in April, May, August, September, October, but no gravid females were among them.

Unio crassidens Lam. Summer breeder (Sterki, '95). I collected numerous specimens in July, August, September, October, but never found a gravid female. I never had a chance to get this species earlier in the season.

Unio complanatus Dillw. "But once annually, from April–May to July–August" (Conner, '07); May (Lea, X, '63). I collected this species only in the month of August, and consequently never found it gravid.

Pleurobema clava Lam. July–August (Lea, III, '42). Found gravid on June 18 and July 10. Specimens collected on May 14 and in August, September and October were not gravid.

Pleurobema aesopus Green. Summer breeder (Sterki, '95). Gravid on July 3 and 13, '08. Never found in the gravid state during August, September, October, when many were collected.

Sterki ('95) places this with the species, in which all four gills are charged, and (Pr. Ohio Ac., 4, '97, p. 391) with the genus *Quadrula*. Yet according to my observations only the outer gills serve as marsupium, and are distinguished at that time by a very peculiar red color; already Lea (X, '63, p. 432) enumerates this species among those which have red eggs, but he saw them only in the ovarium. Yet this "red" of the gills is entirely different from that of certain gravid species of *Quadrula*, being rather of a "lilac" hue.

Quadrula undulata Barn. Summer breeder (Sterki, '95). I collected many specimens in August, September, October, but did not find gravid females. The only one was found on July 3, '08; it had all four gills charged, which were whitish (not red).

Lea (X, '63, p. 417) says that only the outer branchiæ serve as marsupium, while Sterki ('95) puts it in group B, where all four branchiæ are said to be charged.

Curiously enough, Sterki ('95, p. 93) places the closely allied *U. multiplicatus* Lea (= *Q. heros* Say) with his group A (winter breeders), giving the date November 1, and says that also the marsupium is of the type A (*Lampsilis* type). Since the latter has been described and figured by Lea (VII, '60, p. 122, pl. 30, f. 105), and is distinctly of the *Quadrula* type, with all four gills charged, I believe that we have to deal with a *lapsus calami* for *U. multiradiatus* Lea.

Quadrula lachrymosa Lea. May (Lea, III, '42).

Quadrula pustulosa Lea. Summer breeder (Sterki, '95).

Quadrula rubiginosa Lea. July–August (Lea, III, '42); June (Baker, '98). I found this species gravid on May 27, June 30, July 3 and July 8. The marsupium corresponds to the account given of it by various writers; it is formed by all four gills, which are at that time deep red.

Quadrula subrotunda Lea. Summer breeder (Sterki, '95). Found gravid July 3 and July 13. During late summer and fall no gravid females were found, although many specimens were collected. All four gills are charged and of deep red color.

Quadrula kirtlandiana Lea. One gravid female was found on August 2, '07, among hundreds of specimens collected; all four gills were charged, and red. Later in the season, in August, September, October, no gravid females were seen.

Quadrula coccinea Conr. Found gravid on June 18, '08 (Neshannock Creek, McKean Co., collected by Mr. Dennis Dally on June 22, '08. There were, altogether, about a dozen of them, and in every case the marsupium did not agree with the type of the genus *Quadrula*, for only the outer gills were charged in their whole extent, and were whitish. This would remove this species from the genus *Quadrula*, and would place it with *Pleurobema*. (Baker, '98, p. 80, gives a description of the soft parts, and says "four gills used as marsupium," but this may not be founded upon personal observation, but may have been inferred from the systematic position of the species.)

Tritogonia tuberculata Barn. Gravid, according to Sterki (NAUTILUS, 21, '07, p. 48) on June 10, '07, and marsupium formed by all four gills. This would place the species with the genus *Quadrula*, where it would group with *Q. trapezoides* Lea. Since the specific name is preoccupied in this genus, and since none of the synonyms are available, a new name should be found, and I propose here: *Quadrula tritogonia* nov. nom. (I have discussed this point with Dr. Sterki, and he is of the same opinion.)

Of the other species of *Quadrula* found in Western Pennsylvania, *Q. hippopæa* Lea, *cylindrica* Say, *metanevra* Raf., *cooperiana* Lea, *obliqua* Lea, *pyramidata* Lea, *tuberculata* Raf., I have never seen gravid females, and nothing is known about their marsupium and breeding season.

The above observations on the breeding seasons of Pennsylvanian

Unionidæ fully bear out Sterki's division into two groups: summer and winter breeders. The breeding season of the summer breeders is short (maximum hardly four months), while in the winter breeders this season is prolonged, extending from late summer, through the winter into spring. Yet it must be borne in mind that probably in the single individual the breeding season does not fully occupy the whole length of the term, since it has been repeatedly observed that the embryos and ovisacs are discharged at various times, even in the beginning of the winter.

In some species belonging to the group of winter breeders the period of gravidity may be extremely long, so that the end of one breeding season (in May, June, July) may overlap with the beginning of the next (June, July, August), and such species may appear to breed "all the year round." This has been hinted at already by Sterki, and Conner gives the following instances: *Lampsilis radiata* and *Lampsilis nasuta.* My own observations make this condition probable in *Lampsilis ventricosa* and *Lampsilis luteola.* Yet in others an "interim" is very distinct in the early summer. This is the normal condition, according to Sterki, and has been found to be true for *Anodonta cataracta* by Conner, and by my observations it is made more or less probable for *Lampsilis ligamentina*, *Ptychobranchus phaseolus*, *Strophitus undulatus*, *Anodonta grandis*, *Anodontoides ferussacianus*, *Symphynota compressa*, *Symphynota viridis*, *Symphynota costata*, *Alasmidonta marginata.*

These peculiar conditions may be explained by the following assumption: *Quadrula*, with the four gills serving as marsupium, is, in my opinion, the most primitive type of our *Unionidæ.* Next to it stand *Pleurobema* and *Unio*, with only the outer gills serving as marsupium, but with the shell more or less resembling that of *Quadrula.* These forms represent also the most primitive type of the breeding season, which is short, and falls into the warm season. These forms existed already at a time when a uniform warm climate prevailed. At that time, possibly, the breeding season was not so restricted, but at the present time it has become so, since only during a short period of the year these old, primitive conditions prevail (in summer). Forms like *Unio* and *Quadrula* actually go back to mesozoic times.

All other genera are more advanced. The group *Alasmidonta*, *Symphynota*, *Anodontoides*, *Anodonta*, *Strophitus* (which is, according to Sterki, characterized by a peculiar glochidium) resembles in

the marsupium the *Pleurobema-Unio* type, but differs by a general tendency to reduce the hinge teeth. Another group is formed by the rest of the genera, in which the marsupium becomes very highly specialized, more or less restricted to a part of the outer gills, and where true ovisacs are developed. All these more advanced genera originated probably at a time when seasonal changes of climate existed already in our continent—in the tertiary—and the shortening of the warm period in summer possibly induced them to prolong the breeding season, that is to say, to postpone the discharge of the embryos to a more favorable time, namely, till the next spring. This made necessary special adaptations for the carrying of the embryos through the winter, and probably the ovisacs of the most highly developed genera belong to these special adaptations. In certain genera, ovisacs are not at all developed, and in *Strophitus* an independent form (placentæ). This lengthening of the breeding season finally led to the merging of the end of the one of them into the beginning of the next (known only in one of the most highly specialized genera, *Lampsilis*), while in less specialized genera, in *Alasmidonta*, *Symphynota*, *Anodonta*, also in *Ptychobranchus* and some species of *Lampsilis*, an "interim" in midsummer still exists.

I think this is a reasonable interpretation of the different types of breeding season and their development, yet it is proposed here as a mere theory, which should be substantiated by further investigations on the marsupium and the breeding seasons of our *Unionidæ*.

MOLLUSKS FROM AROUND ALBUQUERQUE, NEW MEXICO.

BY H. A. PILSBRY AND J. H. FERRISS.

A considerable amount of work has been done on New Mexican mollusks, and the numerous local lists published would make a good showing for the Territory if compiled into one catalogue. The more recent lists were based upon material collected by Professor T. D. A. Cockerell and his pupils, and by Messrs. Joshua L. and Albert Baily, Ferriss and Pilsbry. The records are to be found in NAUTILUS, ix, p. 116; x, p. 42; xi, p. 69; xii, pp. 76, 131; xiii, pp. 13, 36, 49, 79; xiv, pp. 9, 47, 72, 82, 85; xvi, pp. 57, 69, Mollusca of the Southwestern States, I, II, etc.